INTERAGENCY ECOLOGICAL PROGRAM
2014 ANNUAL WORKSHOP

FEBRUARY 26-28, 2014
LAKE NATOMA INN
FOLSOM, CA

WORKSHOP AT A GLANCE

All oral presentations will be in the Sierra Ballroom and the poster sessions will be held in the Pavilion. Lunch will not be provided but is available at nearby restaurants.

WEDNESDAY, FEBRUARY 26

8:00 – 10:00	IEP Registration and Poster Set-up
10:00 – 10:10	Joint IEP and CWEMF Introduction
10:10 – 11:50	Session I-Modeling Ecosystem Responses to Management Action (Part I)
11:50 – 1:20	Lunch
1:20 – 3:00	Session II – Modeling Ecosystem Responses to Management Action (Part II)
3:00 – 3:20	Break
3:20 – 4:10	IEP Lead Scientist Welcome and MAST Update
5:00 – 7:00	CWEMF-IEP Special Session at the Folsom Sudwerk Brewhouse & Grille: Science Priorities for Planning and Implementing Ecosystem Restoration

THURSDAY, FEBRUARY 27

8:30 – 10:10	Session III – News from the Sturgeon World
10:10 – 10:30	Break
10:30 – 11:50	Session IV – Contaminants: Patterns of Presence and Effects
11:50 – 1:20	Lunch (Early Career Scientist-Mentor Luncheon held concurrently in the Folsom Room)
1:20 – 2:40	Session V – Advances in Uses of Biomarkers to Evaluate Stressor Effects
2:40 – 3:00	Poster Introductions: Poetry Slam Blitz
3:00 – 3:20	Break
3:20 – 5:00	Session VI – Fall Outflow: Updates from Fall Low Salinity Habitat Studies
5:00 – 7:00	IEP Poster Reception

FRIDAY, FEBRUARY 28

8:30 – 10:10	Session VII – Lower Trophic Level Dynamics: From Nutrients to Zooplankton
10:10 – 10:30	Break
10:30 – 12:10	Session VIII – Recent Research in Salmon Ecology
12:10 – 1:40	Lunch
1:40 – 3:00	Session IX – Recent Innovations for Estimating Salmon Survival, Abundance, and Habitat Use
3:00 – 3:05	Presentation of the Bruce Herbold Award
3:05 – 3:20	Break
3:20 – 4:50	Session X – Panel Session & Discussion: Science Priorities for Planning and Implementing Restoration

GENERAL INFORMATION

Overview: The Interagency Ecological Program (IEP) for the San Francisco Estuary/Sacramento-San Joaquin Delta consists of nine member agencies: three State (Department of Water Resources, Department of Fish and Wildlife, State Water Resources Control Board) and six Federal (Fish and Wildlife Service, Bureau of Reclamation, Geological Survey, Army Corps of Engineers, NOAA Fisheries, and Environmental Protection Agency). The IEP also partners with the San Francisco Estuary Institute, the Delta Science Program, and many academic and private scientists. The mission of the IEP is, in collaboration with others, to provide ecological information and scientific leadership for use in management of the San Francisco Estuary. More information about the IEP can be found at http://www.water.ca.gov/iep/.

The annual IEP Workshop serves as a focal point for IEP activities. The program for this year's Workshop is diverse, with many oral and poster presentations offering a full spectrum of current IEP activities. As in previous years, this year's Workshop features a full three-day program with one of those days planned in coordination with the California Water and Environmental Modeling Forum (CWEMF, http://cwemf.org/). The joint IEP-CWEMF oral sessions are on Wednesday, February 26. In addition, CWEMF, the DSC and the IEP have jointly planned a special informal evening event for Wednesday, February 26 to be held at Sudwerk Brewhouse and Grille in Folsom. The goal of this event is to foster engaging and productive discussions among a diverse group of CWEMF and IEP scientists about science priorities for ecosystem restoration. The joint oral sessions on February 26 and the evening poster session on February 27 are open to all registered IEP and all registered CWEMF participants.

Chair, IEP Agency Coordinators: Gregg Erickson (DFW)
IEP Lead Scientist: Anke Mueller-Solger (DSC)
IEP Program Manager: Kelly Souza (DFW)

2014 IEP Workshop Program Committee: Louise Conrad (co-chair, DWR), Gregg Erickson (co-chair, DFW), Brian Bergamaschi (USGS), Patricia Brandes (USFWS), Richard Connon (UC Davis), Brad Cavallo (Cramer Fish Sciences), Kelsey Cowin (SFWCA), Steve Culberson (USFWS), Max Fish (DFW), Stephanie Fong (SFWCA), Kimberly Gazzaniga (DWR), Kathy Hieb (DFW), Kristopher Jones (DWR), Tamara Kraus (USGS), Alice Low (DFW), Jennifer Messineo (DFW), Anke Mueller-Solger (DSC), Lauren Muscatine (UC Davis), Anitra Pawley (DWR), Alicia Seesholtz (DWR), Ramona Swenson (Cardo-Entrix, Inc.), Lori Smith (USFWS), Lynda Smith (Metropolitan Water District), Kelly Souza (DFW), Thomas Williams (NMFS-SWFSC)

WEDNESDAY, FEBRUARY 26

JOINT IEP AND CWEMF INTRODUCTION

10:00 – 10:10 Gregg Erickson (CDFW)

SESSION I – MODELING ECOSYSTEM RESPONSES TO MANAGEMENT ACTION (PART I)

Moderator: Benjamin Bray (EBMUD)

10:10 – 10:30	Overview of Work on Natural Delta Outflow	Paul Hutton and Curt Schmutte, MWD
10:30 – 10:50	Landscape Change in the Delta, 1850-2000: Implications for Ecological Functions	Robin Grossinger, SFEI
10:50 – 11:10	Managing Finite Supplies for Environmental Goals	Walter Bourez, MBK Engineers
11:10 – 11:30	Evaluation of the Effects of Prospect Island Restoration on Sediment Transport and Turbidity	Michael MacWilliams, Delta Modeling Associates
11:30 – 11:50	Collaborative Science Informing Mokelumne River Fisheries Management	Jose Setka, EBMUD

11:50 – 1:20 Lunch: Area Restaurants

SESSION II– MODELING ECOSYSTEM RESPONSES TO MANAGEMENT ACTION (PART II)

Moderator: Steve Lindley (NMFS-SWFSC)

1:20 – 1:40	Recent Developments in a State-Space Model for Delta Smelt Population Dynamics	Ken Newman, USFWS
1:40 – 2:00	Coupled Physical-Biological Models for Investigating the Effects of Complex Management Actions on Sacramento River Chinook Salmon Populations	Steve Lindley, NMFS-SWFSC
2:00 – 2:20	An Agent-Based Model of Chinook Salmon Smolts in the Sacramento-San Joaquin Delta: Effect of Water Exports and Inflows on Survival and Migration Patterns	Doug Jackson, NMFS-SWFSC
2:20 – 2:40	Applying Predator-Prey Models to Reach-Specific Survival Estimates of Juvenile Late-fall Chinook Salmon in the Sacramento-San Joaquin River Delta	Russell Perry, USGS
2:40 – 3:00	A New Era of Delta Science	Peter Goodwin, DSC

3:00 – 3:20 BREAK

IEP LEAD SCIENTIST WELCOME AND MAST UPDATE

3:20 – 3:50	IEP Introduction, Science Highlights, and Program Updates	Anke Mueller-Solger, DSC
3:50 – 4:10	MAST Synthesis Report: 2014 Update	Larry Brown, USGS

5:00 – 7:00 JOINT IEP AND CWEMF INFORMAL BREAK-OUT DISCUSSIONS: SCIENCE PRIORITIES FOR PLANNING AND IMPLEMENTING ECOSYSTEM RESTORATION

Location: Sudwerks Brewhouse and Grille ~ 9900 Greenback Lane, Folsom

THURSDAY, FEBRUARY 27

SESSION III – NEWS FROM THE STURGEON WORLD

Moderator: Alicia Seesholtz (DWR)

8:30-8:50	Examining White Sturgeon Movements in the Delta Using Fish Tracker	Myfanwy Johnson, UC Davis
8:50-9:10	The Influence of Size and Ontogeny on the Behavior of Juvenile Green Sturgeon Near Water Diversion Fish Screens	Jamilynn Poletto, UC Davis
9:10-9:30	Abundance and Distribution of Green Sturgeon During Their Spawning Period	Ethan Mora, UC Davis
9:30-9:50	Evidence of Sturgeon Distribution and Habitat Use in the San Joaquin River	Zachary Jackson, USFWS
9:50 – 10:10	Impact of Water Operations and Overfishing on White Sturgeon	Marty Gingras, CDFW

10:10 – 10:30 BREAK

SESSION IV – CONTAMINANTS: PATTERNS OF PRESENCE AND EFFECTS

Moderator: Stephanie Fong (SFCWA)

10:30-11:00	Changes in Use and Occurrence of Current-Use Pesticides and the Potential Effects on Phytoplankton in the Sacramento-San Joaquin Delta	Jim Orlando, USGS and Jeff Miller, AQUAScience
11:00-11:30	Acute Effects and Mortality Endpoints are Not the Whole Story: Contaminant Impacts from Genes to Populations	Donald Weston (UC Berkeley), Helen Poynton (U. Massachusetts), and Gary Wellborn (U. Oklahoma)
11:30-11:50	Mesocosms: A Tool to Assess Long-term Effects of Pesticide Mixtures on Aquatic Invertebrate Communities	Simone Hasenbein, UC Davis

11:50 – 1:20 Lunch: Area Restaurants

11:50 – 1:20 Early Career Scientist - Mentor Luncheon: Folsom Room

SESSION V – ADVANCES IN USES OF BIOMARKERS TO EVALUATE STRESSOR EFFECTS

Moderator: Richard Connon (UC Davis)

1:20-1:40	Evaluating Stressors in the San Francisco Estuary using Biomarkers	Tracy Collier, DISB
1:40-2:00	Validating Inland Silversides as a Bioindicator Species for the San Francisco Estuary	Richard Connon, UC Davis
2:00-2:20	Delta Smelt Health Part I: Biomarkers as Indicators of Stress and Health	Dolores Baxa, UC Davis
2:20-2:40	Delta Smelt Health Part II: A Composite Health Index Using Biomarkers ("Fish Health Index")	Alireza Javidmehr, UC Davis

2:40 – 3:00 **Poster Introductions: Poetry Slam Blitz**
Moderator: Steven Culberson (USFWS)

3:00 – 3:20 **BREAK**

SESSION VI – FALL OUTFLOW: UPDATES FROM FALL LOW SALINITY HABITAT STUDIES
Moderator**:** Steven Culberson (USFWS)

3:20 – 3:40	Seasonal and Spatial Differences in Organic Matter Quality and Biogeochemistry of Native Fish Habitats in the Delta	Carol Kendall, USGS
3:40 – 4:00	Fall Growth of Delta Smelt Derived from Otolith Microstructure	Jim Hobbs, UC Davis
4:00 – 4:20	Ontogeny Influences Delta Smelt Sensitivity to Climate Change Stressors	Lisa Komoroske, UC Davis
4:20 – 4:40	Estimates of Delta Smelt Hatching Distribution, Population and Entrainment Using Three-Dimensional Hydrodynamic and Particle Tracking Model Results	Ed Gross (Resource Management Associates)
4:40 – 5:00	A Method for Modeling Delta Smelt Growth Using a Combination of Otolith and Length-Only Data	Lara Mitchell, USFWS

5:00 – 7:00 **IEP Poster Reception: Pavilion**

FRIDAY, FEBRUARY 28

SESSION VII – LOWER TROPHIC LEVEL DYNAMICS: FROM NUTRIENTS TO ZOOPLANKTON
Moderator: Brian Bergamaschi (USGS)

8:30 - 8:50	Limnology of the Sacramento Deepwater Ship Channel Between Cache Slough and the Port of West Sacramento	Erwin Van Nieuwenhuyse, Reclamation
8:50 – 9:10	Yolo Bypass as a Source of Delta Phytoplankton: Not Just a Legend of the Fall?	Jared Frantzich, DWR
9:10 - 9:30	Nutrient Dynamics from Liberty Island to Lower Sacramento River	Bryan Downing, USGS
9:30 - 9:50	What Happens When There Is No Wastewater in the Sacramento River?	Tamara Kraus, USGS
9:50-10:10	Increased Food Concentration Broadens Tolerances of San Francisco Estuary Copepods to Abiotic Stressors	Bruce Hammock, UC Davis

10:10 – 10:30 **BREAK**

SESSION VIII – RECENT RESEARCH IN SALMON ECOLOGY

Moderator: Sean Hayes (NFMS-SWFSC)

10:30 – 10:50	When to Bolt, Fry, or Smolt? Using Otolith Strontium Isotopes to Determine Juvenile Salmon Migration Pathways and Survival Across Phenotypes and Hydrologic Regimes	Anna Sturrock, UC Santa Cruz
10:50 – 11:10	Physical Variables Influencing Near-shore Habitat Use of Juvenile Chinook Salmon in the Sacramento River	Michael Hellmair, FISHBIO
11:10 – 11:30	Effect of Release Timing on the Survival of JSAT-tagged Fall-run Chinook Salmon from Battle Creek to the Golden Gate	Steve Zeug, Cramer Fish Sciences
11:30 - 11:50	Reach-specific Movement and Survival Rates of Winter-run Chinook Salmon Smolts in the Sacramento River for 2013	Jason Hassrick, NMFS-SWFSC
11:50 - 12:10	Survival and Movement of Feather River Spring-run Chinook Smolts with Different Release Strategies	Arnold Ammann, NMFS-SWFSC

12:10 – 1:40 Lunch: Area Restaurants

SESSION IX – RECENT INNOVATIONS FOR ESTIMATING SALMON SURVIVAL, ABUNDANCE AND HABITAT USE

Moderator: Patricia Brandes (USFWS)

1:40 – 2:00	Using Models of Occupancy Allowing for Imperfect Observation to Estimate Juvenile Chinook Salmon Habitat Use in the Sacramento-San Joaquin Delta	Noble Hendrix, QEDA Consulting
2:00 - 2:20	Identifying When Tagged Fishes Have Been Consumed by Piscivorous Predators: Application of Multivariate Mixture Models to Movement Parameters of Telemetered Fishes	Jason Romine, USGS
2:20 - 2:40	Diel Activity Patterns of Juvenile Late-fall Chinook Salmon with Implications for Operation of the Delta Cross Channel	John Plumb, USGS
2:40 - 3:00	Genetics Data and Chipps Island Efficiency Estimates for Deriving Abundance of Four Races of Juvenile Salmon at Chipps Island	Patricia Brandes, USFWS

3:00 – 3:05 Presentation of the Bruce Herbold Award

3:05 – 3:20 BREAK

SESSION X – PANEL DISCUSSION: SCIENCE PRIORITIES FOR PLANNING AND IMPLEMENTING RESTORATION

Facilitator: Anke Mueller-Solger (DSC)

3:20 – 4:50	Panelists: Bruce Herbold (Estuarine Ecology Consultant), Jay Lund (UC Davis), Ramona Swenson (Cardo-Entrix, INC.), Chris Bowles (CBEC Eco Engineering

2014 INTERAGECNY ECOLOGICAL PROGRAM

ANNUAL WORKSHOP

POSTER ABSTRACTS

Gut Reaction - A Novel Hydro-acoustic Telemetry Tag for Preventing Erroneous Fate Determination in Tagged Salmonids

Afentoulis V.[1], C. Yip[1], A. Schultz[2], and M. Johnson[1]

[1]California Department of Water Resources, Byron, CA
[2]US Bureau of Reclamation

Prototype HTI acoustic predation tags designed to indicate an acoustic tagged fish had been eaten by a predator were tested by DWR and Reclamation staff at the Tracy Fish Collection Facility's Tracy Aquaculture Facility. Six adult striped bass (> 400 mm FL) were each sequentially fed 10 Chinook Salmon with implanted predation tags. Initial feeding time to predation tag activation time, was recorded for 54 of the 60 predation tags (6 tags failed to activate). Average time for a tag to activate was 57:30:59 (range: 22:18:00 to 140:01:00). Control predation tags (tags turned on but not in predation indication mode) were surgically implanted in to two groups of ten control Chinook Salmon. The control Chinook Salmon were held for at least 30 days post surgery to check for effects of the predation tag on fish health and recovery from surgery. There were 3 mortalities within 2 weeks after the surgical implantation. There were no false positives in the control fish, meaning that the tags did not activate in the target species. Predation tags are a promising new technology for determining the fate of acoustically-tagged salmonids. Once field tested, these tags could be used in many applications to understand the magnitude of predator impacts on salmonids near man-made structures.

Statement of Relevance: Acoustic telemetry allows the location and movements of salmonids to be known, and therefore, water management decisions can be made accordingly. Tagged fish are often consumed by piscivorous predators. Management decisions will be inaccurate if tag detections labeled as live salmonids are actually consumed salmonids.

Physiological Assessment of the "Bad Suisun" Phenomenon: Light and Nutrient Interactions

Berg G.M., R. Kudela, and K. Negrey

Applied Marine Sciences, University of California, Santa Cruz

The focus of this investigation is to determine whether Suisun Bay has consistently higher levels of phytoplankton stress compared with other embayments in the San Francisco Estuary (SFE). The proposed work takes advantage of a new tool that enables direct, in situ characterization of phytoplankton stress by measuring PSII photosynthetic efficiency (Fv/Fm), an indication of phytoplankton "health" which is directly related to growth potential. Direct measurements of Fv/Fm are compared with other variables to advance our understanding of what does and does not contribute to lowered primary productivity in impacted regions. Specifically, this study compares the ability of ammonium (NH_4^+) with the ability of a number of other potential stressors to lower phytoplankton productivity as proposed in the "ammonium hypothesis". Pilot data collected in May of 2012 demonstrated that phytoplankton stress was relatively high in a central region of Suisun Bay. Since these initial findings, additional measurements of Fv/Fm concomitant with NH_4^+, NO_3^-, Chl a, turbidity, DO, irradiance, light attenuation and phytoplankton community composition have been made on three separate occasions in Suisun Bay and along the Sacramento River, a major source of NH_4^+ to Suisun Bay in the northern portion of SFE. In addition, similar measurements have been made on transects throughout SFE on a monthly basis over the course of a year. These data are used to, first, test whether Fv/Fm is a reasonable indicator of phytoplankton health, and second, whether NH_4^+ is driving these changes.

Statement of Relevance: This study will provide the basis for an inexpensive and convenient metric for monitoring ecosystem health (through the direct link between Fv/Fm and impaired phytoplankton health). And, it will establish a direct link between NH_4^+ concentration and phytoplankton/diatom stress and/or inhibition to provide a scientifically-based rationale for choosing a regulatory NH_4^+ concentration.

New Insights from Continuous Monitoring of Nutrient Dynamics in Tidal Wetlands

Bergamaschi B., B. Downing, S. Nagel, P. Kreun, J. Fleck, B. Pellerin, and J.F. Saraceno

US Geological Survey

Characterizing how nutrient dynamics in estuaries are affected by interaction with adjacent tidal marshes is essential for developing accurate nutrient budgets, assessing the impacts of eutrophication, and planning wetland restorations to help mitigate effects of rising population. The difficulty is that water quality and nutrient supply in estuaries change continuously as river flows, tidal- and wind-driven currents, and other physical processes move new water parcels across comparatively static geomorphic settings. We used high frequency, in situ measurements of nitrate and phosphate in concert with measurement of flow dynamics in tidal wetlands to evaluate the wetlands' effects on nutrient dynamics. We report data from two studies in the Delta that show large variability in dynamics, from tidal to seasonal time scales, and speculate on processes driving the observed differences. We found substantial seasonal and episodic variation in the magnitude and direction of net nutrient fluxes, suggesting that long-term, high-frequency observations are necessary in order to evaluate nutrient retention in wetlands. Tidal wetlands cannot be regarded generically as sinks for nutrients.

Statement of Relevance: Understanding how wetlands and shallow water environments interact with Delta waters is critical for assessing the impact of large scale wetland restoration contemplated under the BDCP and for designing restorations that provide the desired ecological functions.

Evaluating the Measured Effects of Outflow on San Francisco Estuary Salinity in WY 2011

Brown R. and A. Huber

ICF International

There is a wealth of available data for evaluating salinity in the San Francisco Estuary. Data collected by the USGS, DWR, and USBR in the Delta and San Francisco Bay during water year 2011 were evaluated to better understand the effects of outflow on seawater intrusion. Water year 2011 was selected because Delta outflow varied widely from approximately 2,500 cfs to 225,000 cfs. Electrical conductivity (EC), flow, elevation, and velocity data collected every 15 minutes at multiple locations, as well as USGS boat survey data were integrated and evaluated. The data show how salinity varies longitudinally and vertically through the SF Estuary as well as how the salinity gradients vary in response to tidal flow and net outflow. At any given location, the daily range of EC values (caused by tidal excursion) is much greater than vertical stratification. Delta outflow is the primary control for seawater intrusion. Other factors such as tidal strength and gravitational circulation play a secondary role. Effective outflow (described as the G-model by CCWD) was used to estimate the daily EC at each monitoring location and to estimate the daily X2 position more accurately than the daily X2 equation. Adding a term representing the high tides of the spring-neap tidal cycle improved the daily EC estimates. Although outflow, X2, and daily average EC values provide an accurate summary of the SF Estuary salinity gradients, the 15-minute data reveal many more interesting hydrodynamic events.

Statement of Relevance: Seawater intrusion in the Delta is an important indicator of habitat conditions and water quality. This evaluation of seawater intrusion helps further the understanding of salinity variability in the western Delta and how it is affected by Delta outflow and other factors.

Effects of Water Year Type on Juvenile Chinook Salmon Size at Emigration in the Lower Yuba River, California

Cadrett P, E. Campbell, and R. Martin

US Fish and Wildlife Service, Lodi, CA

Most Central Valley rivers in California are regulated by large dams, altering the frequency of flood events. Consequently, the amount and accessibility of floodplain habitat may vary considerably across water year types. Annual discharge in the lower Yuba River presently is based on the Water Year Type (WYT) designation from the North Yuba River Index described in the Yuba Accord. Implementation of the Yuba Accord began in 2007 and will continue until at least 2015. Studies have shown that juvenile Chinook Salmon (*Oncorhynchus tshawytscha*) rearing on floodplains may experience increased growth and survival compared to those rearing in-river. Floodplains can provide high quality food resources, which contribute to faster growth rates. Inundated floodplains and off-channel habitat may also improve survival by providing refuge from predators and increase the amount of available rearing habitat. Significant differences in daily mean sizes of juvenile Chinook Salmon exist across WYT in the lower Yuba River. In general, wet years tend to produce the largest juveniles whereas dry years produce the smallest fish. Increasing the amount of floodplain habitat available to juvenile salmon in the lower Yuba River at a variety of flow conditions could increase the overall size of juveniles and lead to higher survival.

Statement of Relevance: The frequency, magnitude, and duration of flood events directly affect the amount of floodplain inundation, growth, and survival of juvenile Chinook salmon supporting the hypothesis that there is a need to restore floodplains in salmon producing streams in the Central Valley.

Modeling the Influence of Fall Outflow and Community Structure on the Delta Smelt Population

Castillo G.

US Fish and Wildlife Service, Lodi, CA

Evaluation of the ecological processes operating in the low salinity habitat (LSH, 1-6 psu) may improve the understanding on the factors controlling the abundance of Delta Smelt. The objectives of this study were to: 1) Model community structure under 3 outflow scenarios, 2) Model the effect of outflow on different species/trophic levels, and 3) compare the response of the Delta Smelt population based on model predictions and field data. Signed-digraphs were used to qualitatively model the response of Delta Smelt under 3 fall outflow levels: low (5,000 cfs), intermediate (8,000 cfs) and high (11,400 cfs). These outflows matched those examined by the Fall Low Salinity Habitat Team, where the near-bottom 2 psu salinity position in the estuary (X2), corresponded respectively to X2 of 85, 81 and 74 km. Community composition for each outflow scenario was determined relative to the geographic location of the LSH. The high outflow community scenario included phytoplankton, zooplankton, Delta Smelt, the overbite clam *Potamocorbula amurensis* and Delta Smelt predators. The intermediate outflow scenario included two additional variables (the Asian clam *Corbicula fluminea* and the cyanobacteria *Microcystis aeruginosa*). The low outflow scenario included the same variables as in the intermediate flow scenario except that the overbite clam was excluded and the Brazilian waterweed, *Egeria densa* was added. Four alternative sustained outflow disturbances (press perturbations) were assumed for each community scenario. The predicted responses of the Delta Smelt population for the modeled outflows were: 1) consistently positive and determinate under the high outflow community scenario, 2) predominantly positive but very uncertain under the intermediate and low outflow community scenarios. Model predictions are supported by the observed Delta Smelt response and are consistent with the hypothesis that the fall outflow action exerts a positive influence on the Delta Smelt population by shifting the LSH towards X2 = 74 km.

Statement of Relevance: The response of the Delta Smelt population to fall outflows is an area of significant interest in terms of environmental policy and adaptive management.

Evaluating the Effects of Release Strategy on Movement and Survival of Fall- and Spring-run Chinook Salmon Tagged with JSATS Transmitters in the Sacramento-San Joaquin Delta

Chapman E.[1], P. Klimley[1], J. Merz[2], J. Kindopp[3], S. Hayes[4], R. Kurth[3], G. Singer[1], A. Ammann[4], R. Null[5], J. Hassrick[4], and S. Zueg[2]

[1]University of California, Davis
[2]Cramer Fish Sciences
[3]California Department of Water Resources
[4]National Marine Fisheries Service
[5]US Fish and Wildlife Service

Acoustically tagged hatchery salmonids have been trucked to release locations low in the Sacramento and Feather Rivers and Delta for many years. The goal has been to increase numbers of fish reaching the lower portions of the system for route selection and reach specific survival studies. Concerns with using these fish as study subjects in the San Francisco Estuary warranted a closer look at a potential release effect. Over 1000 juvenile Fall- and Spring-run Chinook Salmon were tagged with JSATS transmitters and released in the Sacramento and Feather Rivers. One group of Fall-run was tagged and released with the Coleman National Fish Hatchery (CNFH) production, another was tagged at CNFH and trucked to Sacramento, CA for release. The final group was captured, tagged, and released at the rotary screw traps (RST's) above Tisdale Bypass. This strategy was chosen in hopes of determining whether tagging actively migrating fish produces tracks in the Estuary more similar to fish released at CNFH than those released near the Delta. Spring-run fish were tagged at the Feather River Hatchery (FRH) and released at two locations along the Feather River and one in Sacramento. Releases in Sacramento were timed to coincide with the arrival to the Delta of the fish released upstream. Analyzing movements of fish released low in the system that have not undertaken a complete out-migration may be problematic when attempting to extrapolate results to the millions of fish released at or near the hatcheries. Previous studies suggest that mortality is relatively high in the reach below release locations. Our concern is that migratory behavior is also affected, and that results may not be indicative of the greater population of hatchery fish. Detections of fish were analyzed for transit time, straying from the main channel, diel movements, and survival.

Statement of Relevance: Understanding how salmonids move through the Sacramento-San Joaquin watershed is an essential part of making informed decisions about water use and management. We must ensure that the movements that are being analyzed come from fish that are adequate surrogates for the greater population of salmonids in the Central Valley.

Testing the Toxicity Toolbox: A Thorough Assessment of Water Quality in the Sacramento River at Hood, CA

Deanovic L.[1], M. Stillway[1], S. Fong[2], R. Connon[1], D. Denton[3], K. Jeffries[1], S. Teh[1], B. DeCourten[4], and K. Hoffman[1]

[1]University of California, Davis
[2]State and Federal Water Contractors Agency
[3]US Environmental Protection Agency
[4]University of North Carolina, Wilmington

Laboratory toxicity testing is a critical component of aquatic health monitoring across the U.S. and world-wide. The purpose of this study is the application of ex-situ monitoring tools to capture toxicant effects in real-time chronic exposures using *Pimephales promelas*. Lethal and sublethal response endpoints were measured to detect the presence and effects of chemicals in the Sacramento River at Hood (Hood), CA. In addition, standard toxicity tests of grab water samples from Hood were conducted (using EPA promulgated methods) to evaluate the sensitivity between monitoring tools (traditional and ex-situ, lethal and sublethal). Ex-situ exposures contained 145-300 free-swimming fish and 5 buoyantly-caged fish in each of four replicate 60 liter flow-through tanks. Two consecutive 14d ex-situ exposures were conducted over three separate 28d monitoring events. At the termination of each 14d ex-situ exposure, surviving *P. promelas* were sampled for enzyme and molecular analyses. Significant mortality in free swimming *P. promelas* occurred during the first 14d exposure in the ex-situ study, but not in the traditional toxicity test, and there was no significant mortality during the second or third monitoring events. Results from bacterial culture isolation from Hood water and the expression of immune response genes in exposed *P. promelas* suggest that one or more pathogens associated with exposure to river sediment may have affected survival during the first 14d test. Additionally, qPCR results suggest that fish were exposed to compounds that affected expression of genes involved in endocrine-related processes and exogenous compound metabolism. Chemical analyses of water samples combined with assessments of molecular and biochemical responses will help to identify the causes of toxicity at the site, and may uncover additional stressors undetected via traditional single grab water toxicity testing methods. Results from this study provide a basis of comparison among various bioanalytical tools, and will enable managers to select optimal monitoring methods for important water bodies and ecosystems.

Statement of Relevance: Laboratory toxicity testing is a critical component of aquatic health monitoring, and this study tests the application of ex-situ monitoring tools in comparison to standard toxicity testing, for the assessment of toxicant presence and effects. Results from this study will enable managers to select optimal monitoring methods in the future for important water bodies and ecosystems.

The Passage Assessment Database, a State-Wide Inventory of Fish Passage Assessments Publicly Available via the CalFish Website

Elston A.

Pacific States Marine Fisheries Commission

The Passage Assessment Database (PAD) is an ongoing map-based inventory of known and potential barriers to fish in California. The PAD compiles currently available fish passage information from several sources, including federal, state and local government agencies and from non-governmental sources throughout California. The PAD is an important tool for planning and tracking the outcomes of anadromous fish passage improvement projects. For the PAD to be useful as a restoration tool, the data within the PAD need to accurately depict the on-the-ground reality of fish passage constraints, which requires that the PAD be updated regularly and available to fish passage practitioners. The PAD is publicly available via the CalFish website (www.calfish.org).

CalFish, a California Cooperative Anadromous Fish and Habitat Data Program, is a multi-agency website presenting anadromous fish, stream habitat, and migration barrier data in California. The site includes standards and tools used for the collection, management, and analysis of these data. The poster will include an overview of the PAD, recent updates to the PAD, and new applications to access and review PAD data.

The poster will also include information about other CalFish tools for analyzing data, and CalFish datasets available including barrier remediation reports and California Department of Fish and Wildlife priority barriers for removal.

Statement of Relevance: The PAD enables the analysis of the cumulative impacts of barriers on fish migration. It is also an important management tool for determining and tracking the outcomes of fish passage improvement projects. PAD can be used in planning or project development efforts to improve fish passage. PAD allows for analysis of fish passage sites in relation to each other and other aquatic datasets, in the context of the whole watershed.

Length-Weight Relationships of Americorophium in the San Francisco Estuary

Furler A., D. Jordan, S. Slater, and T. Bippus

California Department of Fish and Wildlife, Stockton, CA

Diet studies are an important component in understanding the food web of estuaries and provide necessary information in the management of fish and their habitat. One of the major issues faced during gut content analysis is a lack of completely intact prey organisms. The length of prey allows application of length-weight relationships so to quantify their contribution to diet by weight, nutritional value, and fullness of fish stomachs. Larger, soft- bodied prey items such as larval fish, mysids, and amphipods are often identifiable, but not intact. Among amphipods of the family Corophiidae, antennae are often the only remains found in fish stomachs. There is currently little information regarding the relationships between antennae length, body length, and weight of Corophiidae amphipods.

This study was conducted to determine body length-weight and antennae length-body length relationships of Corophiidae amphipods, *Americorophium spinicorne* and *A. stimpsoni*, collected in the upper San Francisco Estuary. These relationships would give the ability to generate weight estimates of heavily digested individuals. Preserved amphipods were obtained from the California Department of Fish and Wildlife (CDFW) Zooplankton Study mysid samples and from stomachs of Delta Smelt collected by multiple CDFW long-term fish monitoring projects. Intact amphipods were processed at the CDFW laboratory (Stockton, CA) with lengths recorded to the nearest 0.1 millimeter using a dissecting microscope and weights recorded to the nearest 0.00001 grams using an analytical balance. Length-length and length-weight relationships were generated using least squares linear regression (Excel 2010).

We found significant relationships between antenna length and body length, as well as between body length and specimen weight. These relationships will be useful in studies examining contribution of *Americorophium spp*. amphipods to the diet of fishes in the estuary.

Statement of Relevance: This study was conducted as part of the Interagency Ecological Program's (IEP) Fall Low Salinity Habitat (FLaSH) diet studies to provide information in the management of fish and their habitat.

Delta Smelt Captive Refuge Population Update 2013

Ghebremariam T.[1], G. Tigan[1], L. Ellison[1], A. Finger[2], J. Lindberg[1], M. Nagel[1], and B. May[2]

[1]Fish Conservation & Culture Laboratory, University of California, Davis, Byron, CA
[2]Genomic Variation Laboratory, University of California, Davis

Delta Smelt (*Hypomesus transpacificus*) refuge population was initiated in 2008 at the University of California - Davis (UC Davis), Fish Conservation & Culture Laboratory (FCCL) located in Byron, CA and serves as a safeguard in the events of species extinction in the wild. In collaboration with the Genomic Variation Laboratory (GVL) of UC Davis, the refuge population is genetically managed and monitored with the aim of maintaining a captive population genetically similar with wild, through minimization of inbreeding, yearly incorporation of wild fish into the brood stock, and maximizing overall population genetic diversity using the existing aquaculture facilities at FCCL and has progressed to generation-6 (F6) in 2013. Spawning occurred from February 5 to May 17, 2013. By the end of the season 261 full-sibling groups (FSGs) formed and 239 of the 281 FSGs (85 %) created in 2012 were represented in the brood stock pool and 202 FSGs (75.0%) from F5 were successfully spawned and created the F6. In 2013, in total 87 wild fish supplemented, and 75 wild x cultured and four wild x wild crosses were made. Genetic diversity analysis have shown for most loci, allelic richness (Ar) of the F5 refuge population is higher over all generations (F1-F5). The genetic differentiation between wild fish and cultured fish spawned in 2013 was very low ($F_{ST}<0.001$) and not significant ($P<0.004$). These results suggest the refuge population are successfully maintained similar to the wild population at neutral loci.

Statement of Relevance: Development of a Delta Smelt refuge population provides useful information regarding the species biology and assists the conservation efforts in the Bay-Delta. The genetically managed breeding program ensures the captive population does not deviate from the wild, and the refuge population remains a safeguard in case of species extinction.

Interim Science Action Agenda

Goodwin P., J. Bigman, L. Correa, S. Harader, G. Isaac, J. Vinton, M. Roddam, M. Brand, G. Liles, R. Hoenicke, L. Hastings, and C. Enright

Delta Science Program, Delta Stewardship Council

To initiate implementation of the Delta Science Plan (December 30, 2013), an Interim Science Action Agenda will be completed in 2014. It will include a list of priority science actions and questions from existing documents and collaboration with other agencies and programs that produce and utilize scientific information. The process for developing the Interim Science Action Agenda is an expedited and scaled-back version of the process described in Appendix C of the Delta Science Plan. The Interim Science Action Agenda will include near-term priority science questions and needs from existing agency and program plans and documents, synthesis and review panel reports, Delta Independent Science Board memos, and more. It will not include a comprehensive analysis of current applied research, monitoring, data exchange, and modeling efforts that are relevant to the grand challenges of the Delta (Delta Science Plan, Chapter 2) and will be limited to interim actions to be addressed within a two-year time frame.

Statement of Relevance: The Interim Science Action Agenda will be produced by the Delta Science Program in cooperation with the science community. It will include priority science actions that inform management actions and achieve the objectives of the Delta Science Plan.

Effects of Dietary Selenomethionine on the Growth Performance, Tissue Burden, and Histopathology in Juvenile Green and White Sturgeon

Hung S.[1], G. Moniello[2], N. De Riu[2], J. Lee[3], and S. Huang[4]

[1]University of California, Davis
[2]Department of Veterinary Medicine, University of Sassari, Italy
[3]Neurotoxicology Lab, University of California, Davis
[4]University of Ottawa

The effects of dietary selenomethionine (SeMet) (control, 50, 100, 200 mg SeMet/kg diet) were evaluated on an 8-week study using 3-month-old Green (*Acipenser medirostris*) and White Sturgeon (*A. transmontanus*) (30 g ± 2) in a flow-through tank system. Mortality, percent body weight increase, hepatosomatic index, proximate composition of whole body, tissue Se burden (whole body, gill, heart, liver, kidney, white muscle), and histopathology were determined as endpoints. There were significant ($p<0.05$) increases in mortality and depression in growth of both sturgeon species fed SeMet diets compared to the control. Mortality and growth depression of Green Sturgeon fed SeMet diets were earlier and more severe than those of White Sturgeon. Selenium significantly accumulated in all tissues of both species in a dose dependant manner; the Green Sturgeon has the highest Se levels in the liver whereas White Sturgeon has the highest levels in the kidney. There were significant effects of dietary SeMet on the whole body proximate compositions of both sturgeon species where the Green Sturgeon was more adversely affected than White Sturgeon. Marked histological changes were observed at week 4 and 8 in the kidney and liver of both species of sturgeon fed SeMet-added diets. The most severe histological lesions were found in kidneys of both sturgeon species. As such, the lowest observed effect concentration was 25 mg SeMet/kg diet for both species based on the histopathology which was one of the most sensitive endpoints. However, higher mortality, growth depression, lower whole body protein, lipid, energy content and more severe histopathology indicated that Green Sturgeon was more susceptible to dietary SeMet than White Sturgeon in our 8-week exposure experiments.

Statement of Relevance: Our results showed that the Se level of 19.7 mg Se/kg diet (= 50 mg SeMet/kg diet) that had been found in a wild clam species of San Francisco Bay caused serious toxicity in the federally threatened Green Sturgeon. Juvenile Green Sturgeon was more susceptible to dietary selenomethionine toxicity than White Sturgeon. Juvenile White Sturgeon cannot be used as a surrogate species to monitor risk assessment of Green Sturgeon for dietary selenium toxicity.

Salinity Tolerance of the Copepod *Pseudodiaptomus forbesi*

Kayfetz K. and W. Kimmerer

Romberg Tiburon Center, San Francisco State University, Tiburon, CA

Distributions of estuarine organisms are dictated in part by physiological tolerances to salinity, but salinity is not the only factor that determines where species are found. Historical records from the Interagency Ecological Program long-term zooplankton monitoring program show that the introduced calanoid copepod *Pseudodiaptomus forbesi* was once abundant across a broader range of salinity than where it is currently found in the San Francisco Estuary (SFE). Previously this copepod was abundant from freshwater to waters of salinity 5 and higher, however now it is generally found in waters less than salinity 5 and is most abundant in waters of salinity less than 1. This study examined how salinity affects both the survival and reproduction of this copepod, as knowledge of reproductive parameters is crucial to understanding and predicting population dynamics. Laboratory experiments on the acute salinity tolerance of this species indicated that it is physiologically capable of tolerating a much wider range of salinity than it currently inhabits in the SFE. Furthermore, experiments on reproductive output of *P. forbesi* indicate that it is more productive at salinities around 5-8 than it is at salinities 0-2, yet in the SFE it is far more abundant at the lower salinities. This study presents an example of an estuarine organism whose distribution is not shaped by physiological tolerance to salinity but rather by other factors such as interspecific interactions.

Statement of Relevance: Understanding the factors that affect species distribution allow for more accurate modeling of the system under current and future conditions. In particular, since copepods are an important lower-trophic link, understanding the distribution of copepods provides insight into the resources available to higher trophic levels.

Effects of Feed Restriction on Osmoregulation in Green (*A. medirostris*) and White (*A. transmontanus*) Sturgeon Juveniles

Lee S.[1], L. Haller[1], S. Hung[1], N. Fangue[2], J. Lee[3], and J. Fadel[1]

[1]Department of Animal Science, University of California, Davis
[2]Department of Wildlife, Fish and Conservation, University of California, Davis
[3]Department of Marine Bio-Materials and Aquaculture, Pukyong National University, South Korea

Decreased food availability and elevated salinity are key environmental stressors influencing fish populations; however, the physiological consequences of their interaction in sturgeon species are unclear. Green and White Sturgeon, both native species to the San Francisco Bay Delta (SFBD), are species of special concern, and the southern distinct population segment of the Green Sturgeon is listed as threatened in the Sacramento River system. To test the hypothesis that poor nutrition negatively affects osmoregulation, juvenile Green and White Sturgeon at 222 (202g) and 209 (204g) days post hatch respectively, were randomly assigned to four feed-restriction groups (12.5, 25, 50, 100% of optimal feeding rate for four weeks). Subsequently, fish were acutely exposed to salinities of 0 (control), 8, 16, and 24 (for White Sturgeon), or 32 ppt (for Green Sturgeon), and sampled at three time points (12, 72, or 120 hours). Salinity treatment corresponded to environmental salinities juvenile sturgeons are likely to encounter as they out-migrate from their natal freshwater streams. Fully-fed White Sturgeon exhibited 100% mortality at salinities above 24 ppt while Green Sturgeon showed no mortalities at 32ppt, thereby setting the highest salinity treatments for the study. Our data indicate that feed restriction, salinity concentration and salinity exposure time had significant effects on hematological indices (hematocrit, hemoglobin), plasma values (osmolality, Na+, K+, Cl-, glucose, lactate) and enzymatic activity (gill and pyloric caeca Na+, K+ ATPase) in both species with the largest disturbances seen at the highest salinity treatments across all feeding regimes. Additionally, the interaction of feed restriction and acute salinity exposure of the highest salinity treatment resulted in high mortality in Green Sturgeon while no mortality was observed in White Sturgeon. Evaluating the interactions of these environmental stressors and their implications on the physiological tolerance of native sturgeon populations is critical for ecosystem management decisions in the rapidly changing SFBD system.

Statement of Relevance: Decreased food availability and elevated salinity are key environmental stressors influencing fish populations; however, the physiological consequences of their interaction in sturgeon species are unclear. Evaluation of the interactions of these environmental stressors and their implications on the physiological tolerance of native sturgeon populations is critical for ecosystem management decisions in the rapidly changing SFBD system.

Lagrangian Tracking in a Wetland—Promising Technique for Tidal Sampling?

Lee T.[1], B. Bergamaschi[2], F. Wilkerson[1], N. Travis[1], T. Kraus[2], and A. Parker[3]

[1]Romberg Tiburon Center, San Francisco State University, Tiburon, CA
[2]California Water Science Center, US Geological Survey, Sacramento, CA
[3]The California Maritime Academy, Vallejo, CA

Liberty Island (LI) is a shallow, flooded area in the Cache Slough Complex that was restored to its historical status as a wetland from agricultural use by a levee breach in 1998. LI is tidally influenced and subject to nutrient inputs from anthropogenic sources such as agricultural runoff and effluent from wastewater treatment plants. It is hypothesized that by providing shallow waters and long residence times, restored tidal wetlands like LI may mitigate anthropogenic nutrients while enhancing primary production. Shallow waters such as those found in LI may therefore act as a sink for nutrients and a source of particulate organic carbon and chlorophyll-a, which is tidally exported to the Delta to support the pelagic food web. To test this hypothesis, a series of Lagrangian transects were completed during three consecutive days in October 2013. Water parcels were tracked as the water tidally traveled onto and off of LI. Because of the nature of this sampling method, samples are thought to be highly representative of the processes occurring in the water column. Nutrients, chlorophyll-a and photosynthetic efficiency were measured using high-frequency in-situ sensors and by laboratory analyses of grab samples. Here we present preliminary results from the data collection.

Statement of Relevance: The Bay Delta Conservation Plan has determined that the area near Liberty Island has potential to be restored to wetlands. This study addresses the effects that this established, representative wetland has on nutrient flux and phytoplankton production so that decisions regarding restoration might be well founded.

Chironomidae in the Delta: Where Are They?

LeGro M. and H. Fuller

Division of Environmental Services, California Department of Water Resources, West Sacramento, CA

Midge fly larvae and pupae are an important food source for pelagic and open-water shoal fish and little is known about their distribution and habitat preferences in the San Francisco Estuary. A Generalized Random Tessellation Stratified (GRTS) study was conducted from 2007 through 2011. Data were used to determine the abundance and distribution of the Chironomidae family of midge flies throughout the San Francisco Estuary. In May and October of each year the Bay-Delta Monitoring and Analysis section of the California Department of Water Resources sampled 175 sites for benthic invertebrates and substrate using a ponar dredge and measured environmental water quality data. 50 fixed sites were sampled throughout the study and 125 variable sites were sampled each year. Sampling sites were categorized into 7 regions: Central Delta, Confluence, East Delta, Sacramento River, San Joaquin River, South Delta, and Suisun Marsh. Using the three most common genera of the Chironomidae family: *Chironomus*, *Procladius*, and *Psectrocladius*, our results show three main trends. First, Chironomidae larvae and pupae are more abundant in May than October. The majority of Chironomidae larvae and pupae, greater than 80% of the sampled genera, were found in the East Delta, Central Delta, and San Joaquin River regions. Less than 5% of larvae and pupae were found in the Suisun marsh and Confluence regions. Finally, Chironomidae larvae and pupae were most abundant in mixed sediment, followed by clay, and silt. The results of this study illustrate the abundance and distribution of an important benthic food source and will enhance future studies involving diet analyses.

Statement of Relevance: Midge fly larvae and pupae are significant benthic food sources for native California fish in the San Francisco Estuary. Understanding their ecological role and availability in the San Francisco Estuary will help guide future diet analyses.

Developing a SNP Panel for Genetic Management of Delta Smelt, *Hypomesus transpacificus*

Lew R., M. Baerwald, A. Finger, B. May, and M. Meek

Department of Animal Science, University of California, Davis

Since 2008, the Fish Conservation and Culture Laboratory (FCCL) has raised a captive-bred population of Delta Smelt (*Hypomesus transpacificus*) as a refuge to safeguard against extirpation in the San Francisco Estuary. In conjunction with the FCCL, the Genomic Variation Laboratory of UC Davis has genetically managed this population to be genetically similar to the wild population to ensure preservation of standing genetic diversity. We created a panel of single nucleotide polymorphisms (SNP) to augment the microsatellite panel currently in use to genotype fish and assign parentage. Properly implemented, a SNP panel is a more powerful and repeatable method for high-throughput genotyping. This streamlines genetic management, which is performed in real-time during the spawning season. For the SNP discovery, we sequenced 27 individuals of the 2012 broodstock using restriction-site associated DNA sequencing (RAD-seq), yielding 2317 new SNPs. To develop a linkage map to facilitate identification of effective SNP markers for a genotyping panel, we used RAD-seq to genotype three single pair crosses and 46 offspring per family at the 2317 discovered loci. We successfully mapped 1124 loci and identified 26 linkage groups. This information was then used to select 104 loci as candidates for assay development based on minor allele frequency (>20%), neutrality (Hardy-Weinberg equilibrium), and marker location. We evaluated our assays on a 96x96 Integrated Fluidic Circuit (Fluidigm EP1). Eighteen individuals from the RAD-seq study were re-genotyped with the assays to test marker accuracy. We also genotyped 76 samples of known parent-offspring relationship to assess the panel's ability to assign parentage using the program CERVUS 3.0. We found that a panel of 24 independent SNPs, chosen from the 96 total based on the highest minor allele frequency, could successfully assign parents and offspring if each individual used in the analysis was genotyped at a minimum of 19 loci.

Statement of Relevance: This project details the development of new genetic markers for threatened Delta Smelt. These new markers may be used in monitoring and management of the hatchery-raised refugial population and the species in the San Francisco Estuary.

Estimating a Baseline Condition for Landbirds Within the Sacramento-San Joaquin Delta

Melcer Jr. R, C. Feldheim, and D. Tsao

California Department of Water Resources

Historically, the Sacramento-San Joaquin Delta (Delta) was a vast, tidally influenced freshwater marsh, with soils rich in peat and alluvium from the upstream watersheds. Levees built along stream channels and reclamation of lands for agriculture, water, and urban development have reduced wetland and riparian land cover types to less than 5% of their historical extent. These changes have resulted in the decline of the fish and wildlife species dependent upon the Delta ecosystem and associated habitats. The implementation of projects associated with the permitting, operation and maintenance of the water delivery and flood management systems, as well as the reversal of subsidence and greenhouse gas reduction, provide an opportunity to restore thousands of acres of the Delta landscape to more natural land cover types such as managed and tidal marsh, and riparian forests. These landscape scale changes may provide significant benefits to multiple wildlife taxa, including landbird communities; however, the current status of terrestrial birds is poorly understood within the region. In order to address this information gap, we have implemented a multiyear study of the bird communities using agricultural and natural landscapes throughout the Delta. Using repeatable, quantitative data collection methods, this study will provide a baseline condition for measuring restoration success, inform adaptive management processes, and provide region-specific information on bird-habitat associations. We have gathered bird community composition and abundance data, and fine-scale habitat characteristics at sampling plots (n=218) within 25 sites throughout the Delta. The findings of this study provide a novel understanding of the landbird communities throughout the Delta and will be important in tracking bird response to the large-scale restoration and conservation efforts currently being planned and implemented.

Statement of Relevance: This study provides novel information on the existing conditions of avian communities within the Sacramento-San Joaquin Delta, informing ongoing planning processes, and providing a foundation for assessing impacts, measuring change and adaptively managing bird populations.

***Maeotias marginata*, Not So Marginal in Summer Townet Catch**

Morris T.

California Department of Fish and Wildlife, Stockton, CA

The Sacramento – San Joaquin Delta has been noted as one of the most invaded estuaries in the world. Invasive species have been shown to disrupt the food web to the detriment of native species. I present the status and trends of the invasive brackish-water jellyfish *Maeotias marginata* as seen during the California Department of Fish and Wildlife's (CDFW) Summer Townet Survey (STN) from 2007 – 2013. The STN survey samples 40 stations bimonthly from June through August, covering an area from San Pablo Bay to the eastern delta. Jellyfish catch is recorded at each station, with *M. marginata* comprising the majority of total jellyfish catch. These jellyfish have found a suitable niche in this ecosystem, and are seen most often in Montezuma Slough and Suisun Bay. Distribution of *M. marginata* appears to be strongly influenced by both salinity and temperature, with an affinity for low salinities (3 -6 ppt) and high temperatures (19-21°C). The dual life-cycle of this species may enable *M. marginata* medusa to rebound from detrimental conditions found during both wet and dry years. This may explain the rise in medusa presence immediately after wet years. This brackish-water region of the estuary is an important zone for many native fish and zooplankton species. With little competition from other jellyfish species and no natural predators, *M. marginata* may be in direct competition with fishes found in this region.

Statement of Relevance: Monitoring of invasive species such as *M. marginata* is crucial in evaluating the health of the estuary. As a novel predator in this region, these jellyfish have the potential to directly compete for food resources with native fish species such as the endangered Delta Smelt.

Introducing an Improved Continuous Monitoring Network for Water Quality in the Sacramento-San Joaquin Delta

Nagel S., B. Pellerin, J.F. Saraceno, T. Kraus, B. Downing, R. Fujii, and B. Bergamaschi

California Water Science Center, US Geological Survey, Sacramento, CA

Monitoring and observing Delta habitat quality, nutrient availability, mixing and overall conditions are essential for understanding and predicting the success of pelagic organisms, health of the watershed and recreational opportunities. The difficulty is that water quality and nutrient supply vary as stream flow, tides, and wind-driven currents move new parcels of water to and from comparatively static geomorphic settings. Understanding interactions between nitrogen and phosphate cycling, suspended sediment, and plankton dynamics with physically descriptive properties such as flow, atmospheric pressure, wind speed, slope, and position in the Delta is critical to predicting and managing bottom up effects on aquatic habitat in the Delta.

Currently, five continuous water quality monitoring sites are located throughout the lower Sacramento River and North Delta and these sites are co-located with existing flow monitoring stations. The water quality monitoring sites are inter-calibrated and together provide a network to monitor pH, temperature, DO, conductivity, nitrate, DOM, chloropyhll-a, phycocyanin and turbidity. The water quality stations are autonomous and telemeter data in real-time to USGS data servers. The data are then made publicly available via USGS NWIS Web: http://waterdata.usgs.gov/ca/nwis/uv/. Stations are maintained and serviced at regular intervals at which time sensors are cleaned and checked against calibration standards. Data from the sensor network are verified against discrete samples taken both monthly and intensively over periodic ebb to flood tidal cycles. These data are useful for understanding interactions between nutrient supply and landscapeas and provide essential information to researchers exploring other aspects of pelagic habitat quality, algal productivity, and food web dynamics.

Statement of Relevance: The sensor network continuously monitors nutrients (nitrate, phosphate), algal pigments, dissolved oxygen, turbidity and DOM continuously, allow for developing, testing and refining hypotheses related to the IEP conceptual model of POD in the Delta.

Characterizing Nutrient Trends, Loads and Transformations in Suisun Bay and the Delta

Novick E., S. David, A. Malkassian, and J. Wu

San Francisco Estuary Institute

The conceptual model for the Pelagic Organism Decline recognizes that multiple factors may be acting in concert to degrade habitat and contribute to the decline in pelagic fish species in Suisun Bay and the Delta (Baxter et al., 2010). Anthropogenic nutrient loads are considered to be one potential factor: recent studies have suggested that ammonium (NH_4^+) concentrations inhibit primary productivity (Dugdale et al., 2007; Parker et al., 2012), and that anthropogenically-altered nutrient concentrations or ratios are exerting bottom-up pressures on Delta and Suisun food webs (e.g., Glibert et al., 2011). Although the Delta and Suisun Bay receive high nutrient loads from treated wastewater discharges (e.g., Jassby 2008) and from agriculture in the Central Valley (Kratzer et al., 2011), there has been limited systematic study of nutrient processing within the Delta. This poster will describe on-going work related to a project synthesizing nutrient data (DWR/EMP) throughout Suisun Bay and the Delta, and characterize nutrient loads to and transformations within these systems.

Statement of Relevance: We hypothesize that nutrient processes within the Delta have a large impact both on conditions in the Delta and on loads delivered to downstream subembayments. Characterizing this role further will inform near-term and potentially costly management decisions regarding nutrient inputs to the Delta and Suisun Bay.

In Stream Nitrate Dynamics in the Presence and Absence of Effluent in the Sacramento River, CA

O'Donnell K.[1], T. Kraus[1], B. Bergamaschi[1], N. Travis[2], E. Stumpner[1], B. Downing[1], T. Mussen[3], and A. Parker[4]

[1]US Geological Survey, Sacramento, CA
[2]San Francisco State University, CA
[3]Sacramento Regional County Sanitation District, Sacramento, CA
[4]The California Maritime Academy

Research suggests that both the amount and form of dissolved inorganic nitrogen (nitrate versus ammonium) in water affects the abundance, health and species of phytoplankton in the Bay-Delta, which subsequently impacts food stocks for pelagic organisms. The Sacramento River is the primary source of water and a phytoplankton seed source for the Delta. Effluent releases from the Sacramento Regional Wastewater Treatment Plant (SRWWTP) contribute high concentrations of ammonium just downstream of Freeport Bridge. Understanding the rate at which this ammonium is converted to nitrate (nitrification), may help us unravel controls on phytoplankton health. Data for this study was collected from in-situ monitoring stations at Freeport Bridge, located 0.2 km upstream of SRWWTP's effluent outflow, and Walnut Grove, located just upstream of the Delta Cross Channel. Both stations report river velocity and nitrate every 15 minutes along with standard water quality measurements. Effluent flow data was provided by SRWWTP. These data allow us to model net nitrification rates in the Sacramento River along this 29 km stretch between the two stations. Based on the period of record to date (September 2013 to January 2014), we calculated water travel times between monitoring stations and net changes in nitrate concentration. We assumed that effluent contained negligible amounts of nitrate and there were no other nitrate inputs along this river reach. Additionally, three wastewater holds by SRWWTP occurred during the study, allowing for evaluation of changes in nitrate concentration in the absence of wastewater. Preliminary results suggest that during effluent releases nitrate concentrations typically increased between Freeport and Walnut Grove. However, in the absence of effluent, nitrate concentrations decreased, indicating loss of nitrate along this stretch of the river was greater than its production.

Statement of Relevance: Research suggests that both the amount and form of dissolved inorganic nitrogen in water affects phytoplankton health in the Bay-Delta, which subsequently impacts food stocks for pelagic organisms. Understanding the rate at which ammonium is converted to nitrate (nitrification), will improve our understanding of controls on phytoplankton health.

Jellyfish Abundance Not Falling On Fall Midwater Trawl

Osborn K. and M. Avila

California Department of Fish and Wildlife, Stockon, CA

Whether from natural or anthropogenic causes, evidence suggests that gelatinous zooplankton (jellyfish) populations are on the rise in certain ecosystems (Brodeur et al. 1999, Condon et al. 2012). This includes the San Francisco Estuary, where populations of at least three invasive jellyfish species seem to be on an upswing (Mills and Rees 2000). Many jellyfish can compete with fish for food resources or directly consume ichthyoplankton (Shiganova 1998, Schroeter 2008). Although an increase in jellyfish abundance may be detrimental to local fish populations, relatively little information is available regarding their presence in the estuary. So in 2001, the Fall Midwater Trawl (FMWT) Survey began recording jellyfish catch. The FMWT Survey sampled 116 stations monthly, from September to December. Field crews identified and enumerated jellyfishes when catch was small; when catch was high, field crews sub-sampled all jellyfish and scaled up to total catch. Here we summarize catch per unit effort for 6 jellyfish taxa collected on the survey from 2001 to 2013, including four hydromedusae: *Aequorea spp*., *Maeotias marginata*, *Polyorchis penicillatus*, and *Scrippsia pacifica*; one scyphomedusae complex, *Aurelia spp*., and one cydippid ctenophore, *Pleurobrachia bachei*. There was no clear trend in the catch data for these taxa, but most were collected more consistently after 2006. Except for *M. marginata*, all species were only found in a subset of years at the most saline stations. *M. marginata* was found in all years, and was the most abundant and most frequently encountered jellyfish in FMWT catch.

Statement of Relevance: Abundance for most jellyfish species peaks in summer, but adult medusa often persist in the system through fall (Mills 2001). Thus, data from the Fall Midwater Trawl Survey may help illuminate the status of jellyfishes in the estuary, to better evaluate the potential threat they pose to local fish populations.

Using Real-Time In Situ Water Quality Sensors to Detect Wastewater Effluent in the Sacramento River to Help Understand Controls on Nutrient and Phytoplankton Dynamics

Pham T.[1], T. Kraus[1], E. Stumpner[1], T. Mussen[2], A. Story[1], B. Downing[1], B. Bergamaschi[1], and K. O'Donnell[1]

[1]California Water Science Center, US Geological Survey, Sacramento, CA
[2]Sacramento Regional County Sanitation District, Sacramento, CA

Wastewater effluent contributions to the Sacramento River have been linked to changes in nutrient concentrations and phytoplankton health, which may in turn affect fish populations in the Bay-Delta. To investigate this, we conducted a Lagrangian-based study which entailed following parcels of water containing wastewater effluent (+WW) and parcels where effluent was absent (-WW) as they made their way down the Sacramento River and entered the Delta near Isleton, a distance of approximately 45 miles. Wastewater holds (10-18 hours) were coordinated with Sacramento Regional Wastewater Treatment Plant (SRWTP) in April 2013 and October 2013. Critical to this effort was our ability to determine in real-time whether we were collecting samples in the presence or absence of wastewater. To accomplish this, we assembled a novel in situ sensor instrument package and mounted it onto a boat, allowing us to rapidly map changes in water quality as the boat traveled upstream and downstream at approximately 15 mph. Data demonstrated that we could clearly distinguish between water that was wastewater free and water that contained wastewater. Parameters which showed a clear signal included fluorescence of dissolved organic matter (FDOM) and specific conductance. Differences in nitrate were also apparent between the +WW and –WW parcels. Data collected from a fixed station located at Walnut Grove, approximately 18 miles downstream of the WW outflow, which was equipped with a similar suite of in situ sensors also distinctly detected the passage of the -WW parcel.

Statement of Relevance: The generation of real-time, continuous data using in situ sensors for constituents like nitrate, dissolved organic carbon, specific conductivity, dissolved oxygen and chlorophyll-a will allow us to better understand how changes in water quality relating to effluent additions impacts the food web in the Bay-Delta.

Where Do They Go? Critical Unknowns Surrounding White Sturgeon Spawning in California

Schreier A.[1], J. Gruber[2], and J. Frantzich[3]

[1]University of California, Davis
[2]US Fish and Wildlife Service
[3]California Department of Water Resources

Previous investigations of Sacramento-San Joaquin Bay-Delta White Sturgeon spawning behavior have localized the population's spawning habitat to a reach of the Sacramento River between Knights Landing and Colusa. However, the lack of appropriate spawning substrate within that reach, the recent discovery of White Sturgeon spawning on the San Joaquin River, and sporadic White Sturgeon recruitment suggests that there is much we don't know about spawning behavior in this population. Low adult White Sturgeon abundance, below CVPIA targets, and years with low flow leading to negligible recruitment threaten the Bay-Delta White Sturgeon fishery. In order to preserve this popular sport fishery for future generations, we must learn what factors influence Bay-Delta White Sturgeon reproductive success so that we can develop appropriate management strategies. Here we explore uncertainties about Sacramento-San Joaquin Bay-Delta White Sturgeon spawning behavior and propose a research project identifying critical spawning habitat for this species in the Sacramento and San Joaquin rivers. We also propose to identify areas in the Yolo Bypass that attract aggregations of reproductively ready White Sturgeon on their spawning migration to determine if White Sturgeon spawning might be occurring in the Bypass.

Statement of Relevance: Identification of White Sturgeon spawning sites in the Sacramento-San Joaquin Bay-Delta will allow managers to protect these habitats from anthropogenic disturbance. Habitat restoration at these spawning sites may also improve recruitment and stabilize abundance of this valuable yet vulnerable sport fish.

Water and Particle Properties as Measures of Habitat Quality

Story A., K. O'Donnell, and B. Downing

US Geological Survey

Aquatic habitat quality in the Sacramento San-Joquin Delta are dependent on interactions between and among nutrients, suspended sediment, temperature, ph, dissolved oxygen, light attenuation and physical attributes such as substrate, depth and current velocity. Together, these attributes affect the food web by influencing algal production, which affects trophic structure, energy transfer, community structure and fish abundance by impacting foraging behavior and predation.

In conjunction with California Fish and Wildlife's fish collection program in the Delta, we collected water samples and made in situ measurements at 73 stations from Suisun Bay, Grizzly Bay, Montezuma Slough, Cache Slough, Sacramento River and the Deep Water Ship Channel, sampling at the same time and location as the fish collection activities. Preliminary analysis of data has shown spatial and interannual variability as well as a large tidal dependency in important water quality variables. Distributions and interactions between measured water quality parameters across spatial and interannual time scales will be presented in combination with results from in-situ water quality measurements and from analysis of discrete water samples.

Statement of Relevance: Phytoplankton fuels aquatic food webs. Understanding interactions between nutrient cycling, suspended sediment, light penetration, water and plankton dynamics with physically descriptive properties such as chlorophyll production, turbidity, light attenuation and location in the Delta is critical to predicting and managing bottom up effects on aquatic habitat in the Delta.

Real-time Water Quality Mapping in the Cache Slough Complex: High Resolution Data Across Space and Time

Stumpner E., A. Story, T. Kraus, B. Bergamaschi, B. Downing, and K. O'Donnell

US Geological Survey, Sacramento, CA

Water quality measurements collected over fine temporal and spatial scales are both needed to understand biogeochemical processes in hydrologically complex environments, like the Sacramento-San Joaquin Delta, in order to adequately resolve sources and processes. Recently established real-time water quality stations operated by the US Geological Survey are providing temporally-rich data for fixed points in the Cache Slough complex. To complement these data, we collected spatially-intense data using a boat configured with flow-through monitoring tools, enabling real-time mapping of water quality. Real-time mapping can spatially resolve, for example, different sources and sinks for nutrients and phytoplankton, such as agricultural drains, wastewater, and wetlands. We will present data collected over a three day sampling event in October 2013 across Liberty Island and its surrounding wetlands and sloughs using the boat-mounted in situ sensor package. Parameters including nitrate, dissolved organic matter, chlorophyll and algal pigments were measured along with standard water quality measurements (temperature, DO, pH, specific conductance, turbidity). Real-time mapping of water quality has the potential to provide novel information about key processes occurring in dynamic systems, like the Cache Slough complex, to better inform those making water management decisions.

Statement of Relevance: We present spatially-intense data collected across the Cache Slough complex over three days in October 2013 using a boat-mounted in situ sensor package. Real-time mapping has the potential to provide novel information about key processes occurring in dynamic systems to better inform those making water management decisions.

Phytoplankton Community Response to Ammonium-rich Effluent in the Sacramento River

Travis N.[1], F. Wilkerson[1], T. Lee[1], B. Bergamaschi[2], T. Kraus[2], A. Parker[3], and T. Mussen[4]

[1]Romberg Tiburon Center, San Francisco State University, Tiburon, CA
[2]California Water Science Ceter, US Geological Survey, Sacramento, CA
[3]The California Maritime Academy, Vallejo, CA
[4]Sacramento Regional County Sanitation District, Sacramento, CA

Phytoplankton in the Sacramento River receive nitrogen from many sources. One notable input comes from ammonium (NH4)-rich effluent released by the Sacramento Regional Wastewater Treatment Plant (SRWTP). Because nitrogen is a key nutrient for phytoplankton growth, increased availability of NH4 can cause nuisance phytoplankton blooms and eutrophication. However, long-term monitoring in the upper San Francisco Estuary where NH4 is elevated has shown decreased primary productivity and low chlorophyll concentrations. Our aim was to understand how NH4-rich effluent influences the development of phytoplankton communities in the Sacramento River. In collaboration with the SRWTP, a large scale field manipulation of NH4-rich effluent was conducted in which effluent discharge was halted for a 15-hour period in October 2013, creating an effluent-free stretch of river. To investigate the growth and development of phytoplankton over time, samples of river water (with and without effluent) were used to fill 20L mesocosms. Chlorophyll-a production and nutrient draw-down were tracked in the mesocosms over 5 days. In parallel, the same measurements were taken from the river. This design resulted in two general treatments of +/- effluent, which were monitored both in the natural river system and in the mesocosms. Preliminary results show accumulation of chlorophyll-a (up to 20 μg/L) in mesocosms with NH4-rich effluent, yet corresponding river samples containing effluent showed no clear increase in chlorophyll-a over the same 5 day time period. Mesocosms without effluent did not accumulate chlorophyll-a (2 to 6 μg/L), which is likely a result of nitrogen limitation. Chlorophyll-a in river samples with and without effluent both showed slight declines over the study period, and had similarly low concentrations (2 to 8 μg/L). Although phytoplankton have the ability to grow in NH4-rich effluent as seen in the mesocosms, in situ river conditions may include other physical, chemical and environmental factors which limit chlorophyll-a accumulation.

Statement of Relevance: This project is highly relevant to water quality stakeholders in the upper San Francisco Estuary because it aims to understand the impacts of NH4-rich effluent on phytoplankton communities. Effluent manipulation experiments on this scale are rare, and provide an opportunity to study whole river processes, including the response of phytoplankton in situ. Corresponding mesocosm experiments allow for more controlled conditions, yet remain coupled with river measurements.

Recent Progress of the Sacramento-San Joaquin Delta and Suisun Bay Ecopath Model

Wulff M.[1], M. Hasan[2], H. Townsend[2], and L. Brown[1]

[1]US Geological Survey, Sacramento, CA
[2]National Oceanic and Atmospheric Administration

Improvements are being made to the Ecopath with Ecosim* (EwE) Sacramento-San Joaquin Delta and Suisun Bay (herein referred to as the Delta) ecosystem model so that it will be useful as a decision support tool for resource management. To date, we have developed a biomass-based fish food web model of the Delta with Ecopath and initiated hypothesis exploration using temporal simulations of the modeled food web via Ecosim. The current model parameterization of decreased primary productivity and increased submerged aquatic vegetation (SAV) are the best drivers for improving the simulation model's fit to data (relative abundance indices for the pelagic organism decline (POD) species and largemouth bass (*Micropterus salmoides*)). These results support the idea that the Delta has shifted from a pelagic food web to a SAV-associated food web. This initial model is limited because it does not incorporate spatial heterogeneity within the model domain. We are currently developing a spatial component of the EwE model using Ecospace that will allow us to explore how freshwater-pelagic, low-salinity pelagic, and freshwater-littoral food webs interact within the Delta. Spatial modeling is accomplished by identifying foraging, dispersion, and predator avoidance parameters for each functional group (a species or group of species) relative to the range of defined habitats. With completion of the spatial model, we will have a working model of the system that can be used in conjunction with time-dynamic Monte Carlo simulations to explore the possible effects of resource management decisions on the food web dynamics within the Delta ecosystem. This information can be used to help evaluate and optimize the utility and outcomes of such decisions.

Statement of Relevance: With the refinements and spatial addition to our model, we seek to simultaneously examine the effects of multiple potential drivers on one or more POD fishes and place these patterns in the broader context of estuarine food webs and environmental change. We hope that this work will be used as a decision support tool for managers and policy makers.

* Any use of trade, product, or firm names is for descriptive purposes only and does not imply endorsement by the US Government

Economic Implications of Winter-run Chinook Salmon Conservation through Water Management in the Southern Delta

Yoon H.

University of California, Davis

Recent legal restrictions on water exports in the Southern Delta to protect listed fish populations have brought public attention to the trade-off relationship between fish conservation and agricultural economy. The restrictions may result in losses of agricultural returns in the Central Valley. This paper aims to examine the economic costs of conserving the endangered Winter-run Chinook Salmon under different water export reduction scenarios. To consider weather conditions and the corresponding correlations among environmental factors, I chose different water export reduction scenarios under two water year assumptions: (1) Water export changes over the five Sacramento River water years by the California Department of Water Resources: wet, above normal, below normal, dry, and critical and at 10% reduction steps with other environmental factors fixed at a historical average (2) All the environmental factors change over the water years. The agricultural losses for both cases are first calculated by using the Statewide Agricultural Production Model with modified water constraints and calibration procedures. By developing the multi-stage Winter-run Chinook Salmon model that incorporates its life cycle and environmental factors that affect juvenile salmon, including water export, salinity, river flow, and river temperature, the salmon population increases are then simulated for both cases. The combination of both models allows me to assess the economic costs per age 3 and 4 adult salmon. The estimated costs range from $1,304 to $114,966 for the first case and from $864 to $721,120 for the second case. The environmental correlations do not change the order of cost estimates over the water years: critical, dry, wet, above normal, and below normal. The results provide policy-makers with economic data on the tradeoffs in water management for the Southern Delta. One important factor in determining the agricultural losses is a climatic condition and the corresponding dependency of the farms on water exports.

Statement of Relevance: My study is closely related to water and environmental policy and management issues since it measures the economic opportunity costs of increasing Winter-run Chinook Salmon population through water management in the southern Delta in terms of agricultural losses in the Central Valley.